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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : G08B 15/02 — A1

(11) International Publication Number: **WO 99/45514**

(43) International Publication Date: 10 September 1999 (10.09.99)

(21) International Application Number: PCT/US99/03214

(22) International Filing Date: 16 February 1999 (16.02.99)

(30) Priority Data:
09/033,576 3 March 1998 (03.03.98) US

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(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: IDENTIFIABLE MARKING COMPOSITIONS AND METHODS

(57) Abstract

The present invention provides for marking an object with a composition that can later be used to identify the source of the composition. In one embodiment, the composition is a substance that is visually conspicuous and includes a taggant having a chemical code which can link the substance to a discrete source. One source of the substance can be a personnal use size container from which the substance may be expelled as a spray or stream propelled by an appropriate pressurized propellant also contained in the container.

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IDENTIFIABLE MARKING COMPOSITIONS AND METHODS

Field of the Invention

The invention is directed to compositions and methods for identifiably marking an object. Specifically, the invention provides for marking an object with a marking composition containing a taggant which can be correlated with a particular source of the marking substance. In one embodiment, a marking substance of the invention can be sprayed on a person at the scene of a crime and permit subsequent identification and verification that the person was at the scene of the crime.

Background of the Invention

Personal defense compositions for repelling an assailant are known. Such products can also be used by police, military or other authorities for controlling unruly crowds or disruptive persons. Some well known products for this use include tear gas or CHEMICAL MACE®. When sprayed on a human or animal, these products may cause pain and discomfort to the attacker, however, they may not effectively disable the attacker.

A more potent composition that has become popular in recent years and adopted by many law enforcement personnel and the public in general is pepper spray including capsicum and its chemical equivalents, such as capsaicin. See e.g. U.S. Patent No. 5,217,708. While often effective in disabling an attacker, one of the problems with pepper spray is that it can also be lethal. In fact, reports have been filed documenting the death of persons following being sprayed with pepper spray.

Small canisters of pepper spray are available to certain members of the general public which may be carried in a pocket, purse, or held in the hand, so that it may be used as a deterrent to a crime against the person or against one's property. Unfortunately, one of the disadvantages of pepper spray is that it is so potent, that even an unintentional or accidental release can produce catastrophic results. It is because of this potential for catastrophic results that airline passengers are required to reveal the possession of canisters of pepper spray, and airline personnel routinely confiscate canisters of pepper spray from passengers if it becomes known that a canister is being carried.

Another disadvantage of presently available personal defense products is that even if an assailant is fended off by the product, it may nevertheless be difficult to later identify and apprehend the assailant. That is, some presently available personal defense products do not provide a means to conclusively identify

the assailant if his/her face or some other characteristic of the assailant was not noticed by the victim during the criminal act.

One well publicized means for subsequent identification of an assailant that is available today is DNA analysis and correlation with the DNA of a suspected assailant. However, the use of DNA technology requires access and possession of some physical part of a suspect believed to be the perpetrator of a crime. If available, analysis of the DNA present in skin, hair, body fluids, etc., collected at the scene of a crime, has been used to identify a suspected assailant. Unfortunately, it can often be difficult for law enforcement personnel to secure the possession of such samples to enable analysis and comparison with the DNA of a suspect. Moreover, although DNA may be useful for identification of a suspect in some situations, external visualization of the suspect, even immediately after commission of a crime, does not reveal that the suspect has been involved in a crime, thus increasing the likelihood that the suspect can flee and potentially avoid prosecution.

Methods for marking a liquid composition for later identification or association of the liquid with a prior location are known. For example, U.S. Patent No. 5,474,937 discloses adding a chemical element or organic compound labeled with a non-radioactive isotope to a bulk supply of a chemical substance, such as petroleum, for later identification of the source of the chemical substance. However, while the patent discloses methods for bulk products, it lacks guidance for identifying the source of a substance originating from a particular unit of a personal use type product. Moreover, while the chemical substance may be marked, the mark used is generally invisible to the naked eye.

U.S. Patent No. 1,787,995 discloses a method for identification of lubricating oil type liquids by including in the liquid small markers, such as letters or symbols, having the same specific gravity as the lubricating oil. In addition to other deficiencies, this disclosure is also directed to bulk materials.

Accordingly, there is a need for an identifying composition that reliably provides for later identification of a discrete source of the composition. Moreover, there is a need for an identifying composition that readily acknowledges that a material containing the composition is identifiable as to its source.

In addition, in the area of personal defense or crowd control, there is a need to deter disruptive or criminal activity with reduced chance of injury to the victim, perpetrator or uninvolved third parties. There is also a need for increasing the likelihood that the perpetrator of a crime can be identified for apprehension and prosecution of the crime. These and other needs are addressed by the present invention.

Summary of the Invention

The present invention is directed to compositions and methods for marking an object for later correlation with the source of the composition. The compositions and methods disclosed herein are particularly advantageous for identifying a discreet unit source of the identifying composition. The disclosed composition can be included in personal defense type products for humane, and in some cases, conspicuous marking of the perpetrator of a crime. Alternatively, the composition and methods of the invention can also be used with presently available personal defense type products to facilitate identification and apprehension of an assailant.

In one embodiment, the invention provides a taggant which can be included with a composition for identifying a particular source of the composition or taggant. A taggant of the invention includes one or more indicators constituting an identifiable chemical "signature" that is unique for each particular unit container of the taggant or composition. The taggant composition can be correlated with a particular source and a source identification code for the particular composition recorded for later correlation with a particular unit or canister of the chemically coded composition.

In one embodiment, the invention provides a marking substance which can be selectively expelled from a unit container source. According to this embodiment, in addition to a taggant, a marking substance can also include a carrier such as a polymer resin matrix and a visibly detectable label such as a colored pigment, dye, or fluorescent compound.

The marking substance of the invention can be included in a single unit canister for selective dispensing of the marking substance in the form of a spray or stream that may be propelled a considerable distance from the canister. Known propellants can be included in the marking substance for propelling the marking substance from the canister. In addition, other materials such as drying agents and fillers can be used in a composition of the invention.

A composition containing a taggant of the invention can be used to mark many different types of objects. In one embodiment, the invention provides for innocuous marking of a human. Such an application provides law enforcement officials with efficient means for subsequent identification and apprehension of a perpetrator of a crime. In some embodiments, the conspicuous nature of a marking substance of the invention can also act as a deterrent to criminal activity.

Detailed Description of the Invention

The present invention is directed to marking an object with a composition that can later be used to identify the source of the composition. The identifiable composition includes a taggant that can be correlated with a discrete unit source of the composition. One source of the composition can be a personal use size container from which the composition may be expelled as a spray or stream. In one embodiment, a composition of the invention is a marking substance which includes a carrier for tenaciously adhering the substance to a surface and a label that renders the marking substance visibly detectable.

It will be noted that in several places throughout the specification, guidance is provided through lists of examples. In each instance, the recited list serves only as a representative group. It is not meant, however, that the list is exclusive.

In some embodiments, a marking substance of the invention can be carried by, for example, law enforcement officials for humanely marking the hair, skin, clothing, etc. of a large number of people for later identification and verification that an individual was at the location where marking occurred. Alternatively, a herein disclosed marking substance can be carried as a substitute for repellent type personal defense products, allowing a victim to atraumatically mark an assailant for later identification. In yet another embodiment, a taggant of the invention can be included with capsasicum or other repellent type personal defense product for repelling an assailant as well as for facilitating subsequent identification and apprehension of the assailant.

As used herein, an "identifiable composition" is a composition which permits retrospective correlation of the composition with a particular source of the composition. An identifiable composition of the invention can be applied to many objects for marking. As used herein, the term "object" includes animate objects such as humans, plants and animals as well as inanimate objects such as construction materials, shipping crates, weapons, drugs, money, automobiles, etc. A composition of the invention is typically applied to the surface of an object. Examples of surfaces which can be marked on a human include, hair, skin, clothing, etc.

A composition of the invention includes a "taggant" which provides for retrospective correlation of the composition with the source of the taggant or composition. As used herein, a taggant can include a "chemical code" comprising one or more "indicators." The indicators of a particular taggant represent a subset of indicators selected from a larger predetermined set of indicators. The presence and/or absence of each of the predetermined indicators in a subset of indicators is a unique combination of indicators thus providing a unique chemical code for each

taggant. Preferably, for any particular field of marking use, the chemical code of a taggant is not duplicated. That is, each unit source of a composition including a taggant of the invention has a unique chemical code.

A record of the unique chemical code of each taggant can be maintained by a manufacturer and assigned a "source identification code" identifying the particular chemical code of a particular taggant. The chemical code can be represented in the source identification code using any suitable system including, without limitation, numeric or alphanumeric symbols such as a serial number, acronyms, bar code labels, etc. The source identification code can be associated with a unit source of the taggant by marking the source, marking the package of the source, including a registration card with the source that recites the source identification code, etc. A composition of the invention can also be part of a kit including, for example, a registration card reciting the source identification code and/or a retroreflective sticker for application to home, auto or other location to announce use of a taggant product.

As used herein, an "indicator" may be any chemical or biological material which can be identified when a composition containing the indicator is analyzed to determine the indicator's presence. Known methods of analysis can be used to identify the presence of the indicator including, for example, separation, extraction, spectrophotometry, fluorometry, mass spectrometry, gas chromatography, high pressure liquid chromotography, nuclear magnetic resonance spectroscopy, etc. It will be appreciated that the term "indicator" includes an "integrity indicator" as discussed below.

Generally, an indicator of the invention can be non-reactive. As used herein "non-reactive" means that the indicator does not participate in any chemical reaction that may occur in the composition and it does not undergo chemical change or transformation which would preclude subsequent identification of the indicator's presence in the composition. In addition, preferably the indicator will not cause substantial irritation or injury to the surface on which it may be applied. An indicator of the invention can be selected from various families of innocuous compounds including, for example, esters, amides, alcohols, etc. Suitable indicators which are relatively innocuous when applied to an animate object such as a human can, for example, be selected from flavorant and/or fragrance compounds including acetates such as: benzyl; phenethyl; anisyl; geranyl; a-methyl bensyl; p-tolyl; vanillan; amyl; 2-methyl butyl; isoamyl; hexyl; nonyl; decyl; heptyl; octyl; lauryl; cyclohexyl; di-methyl; prenyl; trans-2-hexenyl; linalyl; neryl; and tetrahydrofurfuryl. Compounds not contained in the acetate family may also be utilized.

In addition, for some uses, it may be advantageous to enrich an indicator with a stable atomic isotope. In some embodiments, an isotopically enriched indicator can serve to authenticate that the indicator is from a particular source. For example, if there is a possibility that a composition including the indicator may be comingled with another source of the compound(s) selected as an indicator, such as a natural source, using an isotopically enriched indicator will permit confirmation that the taggant indicator is from the identifiable composition. Examples of suitable stable istopes include hydrogen-2, carbon-13, oxygen-17, fluorine-19, nitrogen-15 and oxygen-18.

To ensure that the chemical code of a taggant has not been compromised, an "integrity indicator" can be used. As used herein, an "integrity indicator" is an indicator included in a chemical code that has increased vulnerability to loss, damage or other failure of detection under the conditions in which the taggant may be used. Factors which can affect a failure of detection of an integrity indicator under particular conditions include, for example, molecular size, molecular weight, chemical structure, electrical charge, volatility, etc. Thus, for example, an indicator having a volatility greater than other indicators of the taggant can be added to the taggant. The presence of the added volatile indicator in subsequent analysis can confirm that the remaining indicators of the taggant have not been compromised by volatilization.

A herein described taggant can be admixed with other components to increase the duration of detectability of the taggant, render a tagged composition visible, increase adhesiveness, increase the surface area that can be coated by the tagged composition, etc. Generally, for any particular composition, the taggant is selected for ability to disperse homogeneously throughout the composition. Homogeneous dispersion ensures that analysis of any portion of a composition, before or after application, will reveal the entire chemical code correlated with a specific container. In some preferred embodiments, an identifiable composition can maintain a homogenous dispersion for at least 6 months to 2 years without the need for shaking or other mixing to redisperse the taggant.

A marking substance of the invention can also include a "carrier." One example of a carrier is a polymer resin matrix, such as an adhesive or coating resin. The carrier can function to facilitate adherence of the taggant to a surface on which the composition is applied and/or preserve or "encapsulate" the taggant in a robust environment. That is, the carrier can preferably withstand a significant amount of abuse and contamination without loss of chemical code information or degradation of the taggant constituents after the carrier has "set-up." In the present context, "set-up" includes curing or drying. As used herein the term "cure" means

that the carrier has completed reactions that render the carrier infusible or chemically inert, such as completion of cross-linking reactions. The term "dry" means that solvents used to keep the resin carrier in a dispensable state, such as a liquid, are no longer present (e.g., evaporated). In some embodiments, it may be advantageous for the carrier to leave a "trail of evidence" by transferring or smearing to additional surfaces before or after set up. Thus, for example, the marking substance can transfer before drying or after drying but before curing. Additionally, or alternatively, the marking substance can transfer by exfoliating from, for example, a human assailant, over a period of several days, after curing.

The dry time of the carrier can be varied. In some embodiments, dry time can be measured in days. In some embodiments, a dry time of between about 1 to 600 seconds, preferably about 30 to 240 seconds is selected as it is fairly quick yet will remain in an undried state long enough to create additional "tell-tale" evidence such as permanent fingerprints, similar to fingerprints left on a paint brush handle when painting. The carrier can also be selected to preserve the taggant, perhaps for many years, thus increasing longevity and the amount of evidence available in, for example, a criminal investigation.

In a preferred embodiment the carrier has a viscosity range of about 50 to 1000, preferably about 100 to 200 centipoise at ambient temperatures. In some embodiments for human application, the carrier can be chosen for its ability to adhere to human hair, skin, clothing, and most other similar surfaces that it may come into contact with while curing. Examples of suitable carriers include alkyds, acrylates, styrenes, etc. One preferred carrier is a polymer resin matrix, such as a phenolic modified alkyd, available as product number 057-5703 from McWhorter Technologies, Minneapolis, MN.

A marking substance can also include additives. Such additives include a solvent for adjusting the viscosity of the carrier. Examples of suitable solvents include acetone, xylene, perchloroethylene, etc. Filler materials such as fumed silica, diatomaceous earth, titanium dioxide, etc., can also be added. One filler material, titanium dioxide, can be added to enhance visibility of a resin carrier. Other additives include one or more drying agents such as cobalt, zirconium and/or other metallic driers which function to enhance cure time of the composition when sprayed onto an object, such as a person or clothing, or when exposed to the atmosphere.

A marking substance of the invention can also include a label. As used herein, a "label" refers to a compound that renders the substance visibly detectable. This includes, for example, colored pigments, dyes, fluorescent compounds visible with or without ultraviolet light rays, etc. In an embodiment

including a polymer resin matrix for human application, preferably, the label will adhere to, and visibly mark human skin, hair, fingernails, etc., for a period of several days despite the exfoliation of the resin matrix that may occur during this interval. Preferably, the label is not easy to remove by the use of commonly known aqueous or organic solvents such as soap and water, rubbing alcohol, minerals spirits, etc. One example of a suitable label are dyes sold under the trademark DayGlo®, available from DayGlo Corporation, Cleveland, OH. Other suitably aggressive colorants can be used in a dye/resin combination of a marking substance such as Hansa yellow pigment, or iron oxide yellow pigments, etc.

The use of a label that is a bright colorant can advantageously provide visual identification of a criminal assailant. This is particularly true if the colorant is conspicuous such as a bright yellow or glowing fluorescent color. Since many police apprehensions of criminals are carried out with the assistance of the general public, a visible colorant can act to alert the public that a marked individual has probably been involved in a crime, thus facilitating the apprehension process. For example, in one embodiment, the inventors foresee a common color scheme for use on packaging, advertising, and included with an identifiable composition to create public familiarity, thus increasing the efficacy of a marking substance product as a deterrent to criminal activity. By combining a label with a resin matrix, the visual identification aspect of the label can be prolonged.

In some embodiments a taggant composition of the invention can be supplied in a personal use container. As used herein, a "personal use container" refers to a container that can be carried by a person, for example, in a purse, on a belt, in a coat pocket, etc. Preferably, the container is hand operated for selective release of the composition from the container using an actuator button. Suitable actuator buttons are known and include nozzles such as safety nozzle systems presently in use. Examples of suitable actuator buttons include No. 8-PA available from Omega USA.

A larger "personal use container" for use by, for example, law enforcement officials, can include a larger hand operated device about the size of a fire extinguisher. In addition, it is foreseeable that a marking substance of the invention can be in a container located for public access such as presently available fire extinguishers for emergency use.

The container can also include an aerosol propellant such as propane, isobutane, dimethylether, compressed nitrogen, compressed carbon dioxide, or other similar propellants or mixtures thereof, at appropriate pressures for dispensing the product from the container. A hand-held container can be sized for holding a total volume of non-propellant ingredients of approximately 1 to 3 fluid ounces.

Containers utilizing greater volume may of course be utilized. A high flow-rate valve such as manufactured by Precision Valve Co. can be used to expel the majority of the contents within a short period of time, for example, 1 to 10 seconds. Thus, for example, an identifiable composition of the invention can be packaged in a small aerosol container and used as a hand-held unit for personal security.

The actuator button is preferably of such design that it can spray the material from the container to a target object in a splattering, "shotgun" type pattern, or a concentrated stream with a range of about 5-20 feet, preferably at least about 8 feet. The design of the activator button preferably minimizes the possibility of accidental discharge while maintaining convenience and ease of use. Several good safety nozzle designs are currently in use on available consumer and law enforcement products, and could be used for the substance described herein.

One example of a suitable personal use container is an aluminum tube-type, such as model number 40-2, available from Peerless Tube Co. Preferably, the canister is equipped with a locking nozzle and collar, such as model numbers 8-PA and 18-NAS, respectively available from Omega USA, and a valve assembly such as model #AR-74 available from Seaquist. This type of canister, or a similar canister, can be adapted for use with any one of a number of different aerosol propellants, such as listed above, or other similar propellants or mixtures thereof, which may be used at various appropriate pressures or selected special pressures to fulfill a specific need. For instance, individual containers may be equipped with nozzles that may be adjustable to produce a spray of the compound when expelled from within the canister, or to squirt a stream of the compound for an extended distance from the canister.

As discussed above, one aspect of the invention provides an improved method and means of identifying and apprehending suspected criminal assailants. Thus, in one embodiment, the invention comprises individually formulated chemical lots of pressure-sprayable compounds contained in individual canisters. In one preferred embodiment, the pressurized container includes a carrier, such as a polymer resin matrix; a visible label; and a taggant. Additional constituents may include solvents, fillers, drying agents, etc.

However, a herein described taggant may also be included in known personal defense spray products. These products, such as pepper spray or compounds including a tear gas such as ortho-chlorobenzalmalononitrile or chloroacetophenone (e.g., MACE®), can be disabling to the person sprayed to provide an opportunity for the victim to escape or secure help in further subduing an assailant. The inclusion of a taggant, with or without other components disclosed herein, can further provide for identification of the assailant.

A substance or composition bearing a taggant unique to each individual unit container, serves to add a conclusive link between a specific container and surfaces that the taggant-containing material from that container adheres to, such as skin, hair, clothing, carpet, wood, concrete, automobile paint, glass, plaster walls, etc.

The following examples are presented for purposes of explanation, and are not intended to limit the number of different embodiments of the invention that may be constructed.

EXAMPLES

EXAMPLE 1:

A three fluid ounce aerosol canister was filled with two fluid ounces of McWhorter 57-5703 alkyd resin matrix material diluted to 50% solids in acetone. One gram of Keystone Keyplast Yellow R, #806-043-50, a bright fluorescent dye, was added to the resin for visibility. A unique chemical code consisting of ester flavorants was formulated directly into the canister. The esters were added to effect a detectable concentration in the resin matrix. This enables definitive retrospective analysis by gas chromatograph and/or mass spectrometry. For dispensing purposes, the indicator esters are diluted 1:10 in xylol as a solvent. At this concentration, additions of one tenth of one milliliter of each required diluted indicator ester will provide a detectable amount in the two fluid ounces of the mixture. Following admixture in a specific canister, an aerosol valve, cup, and dip-tube assembly is crimped onto the canister as is common in the aerosol industry. Compressed nitrogen at 125 psi is added to the canister to serve as a propellant. A spray nozzle is then assembled onto the valve as is commonly known in the aerosol spray industry.

For this Example, the carboxylic esters are chosen from the group including geranyl acetate, nonyl acetate, decyl acetate, linalyl acetate, di-methyl acetate, cyclohexaneethyl acetate, lauryl acetate, citronellyl acetate, vanillin acetate and cyclohexyl acetate. Each indicator represents the binary numerical places 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10, respectively. A unique decimal serial number, say 276, is printed on the canister. The binary equivalent of the decimal numeral 276 is 100010100. Thus, the binary numerical places 3, 5 and 9, counting from right to left, have ones (1), and the other places 1, 2, 4, 6, 7 and 8, have zeroes (0). The indicators that represent the numerical places 3, 5 and 9, are decyl acetate, di-methyl acetate and vanillin acetate, respectively. These constituents are added to the canister. Each canister is assigned its own unique serial number, and thus, its own chemical code corresponding to that serial number. This ensures that the content of each canister is unique and traceable to that canister alone.

In addition, an integrity indicator, such as heptyl acetate can be added to the composition in all canisters to later confirm the presence of all taggants originally formulated into each unique chemical code. In the present example, heptyl acetate was chosen because it has been shown to be lost from the resin matrix before other indicators . The higher volatility will cause the concentration of the heptyl acetate to decrease faster than the concentration of any of the other individual carboxylic esters listed above. During retrospective analysis of a given resin sample, detection of the presence of the integrity indicator confirms the presence of all other individual taggant constituents formulated into that given chemical code.

EXAMPLE 2:

In a real life scenario, consider that the canister of Example 1 is in the possession of an individual, to be used for the marking and identification of a prospective criminal-attacker, should the occasion arise. The individual is subsequently attacked and the individual discharges the contents of the canister onto the hair, skin and clothing of the attacker. Before the resin matrix has dried, the attacker handles objects such as a doorknob and a steering wheel leaving fingerprints visually enhanced by the fluorescent resin matrix. While the resin is in the uncured state, it also collects hairs and fibers from the scene of the crime, adhering them to the attacker.

The marked attacker is later visually identified by the fluorescent dye. A ten-milligram sample of the resin matrix is collected from the attacker and analyzed to reveal the unique chemical code. A match between the chemical code formed by the indicators on the suspected attacker and the chemical code derived from the indicators in the victim's canister conclusively places the suspect at the scene of the crime. This chemical code also matches the serial number printed on the canister. Further investigation shows that the fingerprints left at the scene and in the suspects car are those of the suspect. Hair and fibers from the crime scene are also found on the suspect. Thus, in this scenario, the visibility of the resin matrix on the marked attacker has aided in the identification and apprehension of the suspect. The adhesive properties of the resin matrix and the individual unique chemical code of the taggant in the canister have provided evidence that can be used for conviction of this attacker.

EXAMPLE 3:

A canister such as that of Example 1, is carried by a woman while jogging in a secluded area of a public park. The woman is attacked. During the struggle she discharges the contents of the canister onto the attacker, however, about

25% of the contents is sprayed or smeared on the woman, her clothing, and the jogging path. The attacker attempts to wipe the sticky resin from his face, hair, and clothing, transferring his hair and clothing fibers, mixed with resin to his hands. Further struggle with the woman transfers his hair and fibers from his hands to the woman's face and arms.

Realizing he has been "tagged", the attacker takes the canister from the woman in an attempt to conceal evidence and flees. Criminal investigators collect samples of the resin from the victim and the crime scene. They also find the attacker's hair on the victim. Chemical analysis of the resin matrix samples reveal that taggant esters geranyl acetate, nonyl acetate, lauryl acetate and cyclohexyl acetate, representing numerical places 1, 2, 7 and 10, are present. This corresponds to the binary number 100100011, which is equivalent to the decimal serial number 579 printed on the canister. Analysis also detects the heptyl acetate integrity indicator, which confirms the presence of all indicators originally formulated in the resin matrix being analyzed, ensuring that the complete chemical code is intact.

Two days later, one of the attacker's neighbors sees the fluorescent resin matrix material adhered to the hair behind the attacker's ear. Recognizing the fluorescent resin as a known criminal marking material, the neighbor calls the police. Analysis of resin matrix samples taken from the suspect reveal the presence of the heptyl acetate integrity indicator, and the esters geranyl acetate, nonyl acetate, lauryl acetate, and cyclohexyl acetate, correlating with the binary number 10010001. This places the attacker at the scene of the crime and allows criminal investigators to focus their investigation.

EXAMPLE 4:

A resin matrix sample including a chemical code taggant is collected from the cuticles of a crime suspect's fingers. Chemical analysis reveals the presence of the heptyl acetate integrity indicator, along with the presence of three other esters forming the chemical code of this sample. If the integrity indicator has not evaporated or been washed away by solvents, the other individual esters in the particular formulation are also present. Thus, the presence of the integrity indicator can confirm that the three esters are the only taggant constituents used in this chemical formulation, thus matching the sample taken from the suspect's cuticles, and identifying him (or her) as having been at the scene of the crime.

EXAMPLE 5:

A fluorescent yellow resin substance is recognized and collected at a crime scene. Chemical analysis reveals the presence of the integrity indicator,

heptyl acetate, along with indicators correlating with binary number places 1, 3 and 8. Because the integrity indicator is present, it is known that esters representing binary number places 1, 3 and 8 were the only esters used to formulate the chemical code in question, indicating that the true binary numerical analog is 10000101. This corresponds to the decimal serial number 133 printed on the canister from which the resin matrix sample emanated.

EXAMPLE 6:

A canister such as described in Example 1 is purchased and given to an eight year old child. The serial number on the canister is recorded by the parent and a registration card is filed with a law enforcement agency. The registration card can recite the child's name and address along with a source identification code such as a serial number and canister manufacturer. Six months later the child disappears from its neighborhood. Criminal investigators interview known pedophiles in the area. During an interview, investigators recognize a fluorescent paint-like substance on the hands of the person being interviewed. A search warrant is obtained, leading to the discovery of more evidence. Chemical analysis of the resin found on the suspect and in his car reveal the chemical code registered to the missing child. The suspect is arraigned on charges of child abduction.

EXAMPLE 7:

A mugger threatens a man, ordering him to hand over his wallet. The man sprays the mugger with a substance from a canister such as the one described in Example 1. Knowing he has been tagged with a visible, unique chemical code, the mugger flees. A police report is filed, recording the source identification code, e.g., a serial number, of the canister from which the substance was sprayed. One week later the mugger is arrested in connection with a different crime. The arresting officer recognizes small but visible traces of the marking substance under the mugger's fingernails. A warrant is obtained to search the mugger's home. More of the fluorescent resin material is found in the drain of the mugger's shower. The resin material is collected and analyzed, revealing a chemical code profile. Investigators contact the manufacturer of the substance to obtain the serial number that coincides with the chemical code. The serial number given by the manufacturer corresponds with the serial number on the previous police report, thus connecting the mugger to the previous crime.

EXAMPLE 8:

A field of fifteen "indicators" can be chosen from FDA approved carboxylic esters. Many of these esters can be found in commercially available consumer products and thus presence of the indicators associated with the presence of a particular identifiable composition may be argued to be a contaminant. To belay any doubt at a later time of the origin of the esters, the esters can each be partially enriched with a stable isotope, for example, C-13. According to this example, assume that the natural concentration of C-13 in carboxylic esters is less than 1%. Hence, the fifteen taggant esters are enriched to have a level of C-13 greater that 1%, for example, of 2% or higher to distinguish them as products from the specific source of manufacture. In a given situation, perhaps an enrichment of 5% or more may be required so that after the taggant is diluted in a composition to be tagged, chemical analysis will reveal a detectable enrichment level of C-13. To accomplish this, the selected esters are chemically constructed using C-13 as the labeling isotope, and mixed with the same non-labeled esters to a concentration of 5% or more of each ester. The resulting esters, with a C-13 enrichment greater than natural levels, are then used as individual indicators in the formulation of the final chemical codes.

EXAMPLE 9:

Another method for authenticating the source of the indicators of a taggant is to chemically modify the indicators in a manner that creates an atypical or unique structure of the indicator. For example, in the case of the esters recited in Example 1, the esters can be halogenated using known esterification methods. Such methods include, for example, use of a halogenated acetic acid such as chloroacetic acid. The halogenated form of the ester can be readily differentiated from the common esters using, for example, a gas chromatograph equipped with an electron capture detector.

EXAMPLE 10:

The present example illustrates the use of an isotopically labeled indicator for authenticating the source of an indicator in a taggant. Assume, for purposes of the example, that an accused suspect is on trial and a marking substance such as that described in Example 2 was collected from the suspect's hair. The defense argues that the chemical code contained in the marking substance is inconclusive because the evidence may have been contaminated. The prosecution has the evidence examined by mass spectral analysis. Analysis shows that the indicators of the chemical code are isotopically enriched to a concentration greater

than the natural levels for the indicators. This authenticates the source of the esters as being from the marking substance rather than a contaminating source.

In one aspect, the invention also contemplates a registration system for source identification codes. To create an accurate registration system, each unit container of a marking substance is preferably imprinted with an individual source identification code that may be cross-referenced to the chemical code defined by the indicators or taggant in that particular container. The registration system can then provide the identification of the buyer of the canister containing the taggant of the substance when analyzed. Registration cards can be supplied with the product to facilitate this process, or the source identification code may be included as part of the information contained in an appropriate bar code imprinted on each container or on a label thereon.

It will be apparent to one of ordinary skill in the art that many changes and modifications can be made in the invention without departing from the spirit or scope of the appended claims.

WE CLAIM:

1. A substance that can be selectively expelled from a source for marking an object, the substance comprising:

(a) a curable carrier that adheres to the object marked;

(b) a label that is visibly detectable; and

(c) a taggant that identifies the source of the substance.

2. The substance according to claim 1 wherein the taggant includes a chemical code.

3. The substance according to claim 2 wherein the chemical code comprises at least one indicator.

4. The substance according to claim 3 wherein the chemical code includes at least one indicator selected from the group comprising benzyl acetate, anisyl acetate, geranyl acetate a-methyl acetate, p-tolyl acetate, vanillan acetate, amyl acetate, 2-methyl butyl acetate, isoamyl acetate, nonyl acetate, decyl acetate, heptyl acetate, octyl acetate, lauryl acetate, and combinations thereof.

5. The substance according to claim 3 wherein the taggant is enriched with a non-radioactive isotope.

6. The substance according to claim 3 wherein the indicator is halogenated.

7. The substance according to claim 1 wherein the label comprises a colored pigment that renders the substance visible when applied to a surface of the object.

8. The substance according to claim 1 wherein the label comprises a brightly colored pigment that renders the substance conspicuous when applied to a surface of the object.

9. The substance according to claim 8 wherein the brightly colored pigment renders the substance yellow in color.

10. The substance according to claim 1 wherein the label comprises a compound that renders the substance fluorescent.

11. The substance according to claim 10 wherein the label comprises a compound that renders the substance fluorescent under ultraviolet light.

12. The substance according to claim 3 wherein the taggant comprises at least one indicator that is homogeneously distributed throughout the substance.

13. The substance according to claim 1 wherein the object marked is a human.

14. The substance according to claim 13 wherein marking the human with the substance on a hand or foot causes the human to leave a foot print or hand print, respectively.

15. The substance according to claim 1, wherein the substance has a viscosity enabling dispersal of the composition in the form of a spray.

16. The substance according to claim 1, wherein the substance has a viscosity enabling dispersal of the composition in the form of a stream.

17. The substance according to claim 1, wherein the polymer resin matrix comprises an alkyd.

18. The substance according to claim 1, wherein the substance further comprises a solvent.

19. The substance according to claim 1, wherein the substance further comprises an additive.

20. The substance according to claim 1, wherein the substance comprises at least one drying agent.

21. The substance according to claim 1 wherein the taggant comprises a carboxylic ester.

22. The substance according to claim 1, wherein the taggant comprises an ester that is a flavorant.

23. The substance according to claim 1, wherein the taggant comprises an ester that emits a fragrance.

24. The substance according to claim 1, wherein the taggant comprises an ester that is a flavorant and emits a fragrance.

25. The substance according to claim 19, wherein the additive is selected from the grouping comprising: fumed silica, diatomaceous earth and titanium dioxide.

26. The substance according to claim 1, wherein the taggant comprises a chemical compound detectable and identifiable through chemical analysis.

27. The substance according to claim 1, further comprising an aerosol propellant.

28. The substance according to claim 1 wherein the aerosol propellant is selected from the group comprising: propane, isobutane, dimethylether, compressed nitrogen and compressed carbon dioxide

29. The substance according to claim 1 wherein the source of the substance is a personal use container.

30. The substance according to claim 29 wherein the personal use container is a canister having a locking nozzle.

31. The substance according to claim 29 wherein the personal use container is a canister having a safety nozzle and cap.

32. The substance according to claim 29 further comprising an aerosol propellant.

33. The substance according to claim 2 wherein the source of the substance is a personal use container which includes a source identification code correlating with the chemical code.

34. The substance according to claim 29 wherein the personal use container is included in a kit, the kit further comprising a registration card which recites a source identification code.

35. The substance according to claim 29 wherein the substance in the personal use container is included as a kit, the kit further including a retroreflective sticker indicating presence of the substance.

36. The substance according to claim 33 wherein the source identification code is a numerical code.

37. The substance according to claim 32 wherein the source identification code is in the form of a bar code.

38. A personal defense substance including a taggant.

39. The personal defense substance according to claim 38 wherein the taggant includes a chemical code.

40. The personal defense substance according to claim 38 comprising capsicum.

41. The personal defense substance according to claim 38 comprising a tear gas agent.

42. A method for identifiability marking a human comprising a step of:

- applying to the human an identifiable composition that can be selectively expelled from a source

wherein the identifiable composition comprises a taggant that can be correlated with the source of the indentifiable composition and the source of the composition is a personal use size container.

43. The method according to claim 42 wherein the identifiable composition further comprises:

(a) a carrier that adheres to the person; and

(b) a label that is visibly detectable.

44. The method according to claim 43 wherein the identifiable composition is applied to the human during commission of a crime by the human.

45. A taggant which can be included with a substance for identifying a particular source of the taggant, the taggant comprising:

- a subset of indicators selected from a predetermined set of indicators wherein the presence and absence of each of the indicators of the predetermined set of indicators in the subset of indicators identifies the particular source of the taggant.

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/US 99/03214

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G08B15/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G08B G01N C12Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X,P	GB 2 319 337 A (PROBE FX PATENTS LIMITED) 20 May 1998 see claims 1-26	1-45
Y	NL 9 301 405 A (PIET HEIN HEEZEMANS) 1 March 1995 see page 2, line 7 - line 15	1-45
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A	US 5 474 937 A (ANDERSON II DAVID K ET AL) 12 December 1995 see abstract	5

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 June 1999	25/06/1999

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INTERNATIONAL SEARCH REPORT

Interr nal Application No
PCT/US 99/03214

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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